# ПЕДАГОГИЧЕСКИЕ НАУКИ

## PEDAGOGICAL RESEARCHES AND THEIR STATISTICAL ANALYSIS IN THE FORMATION THE CONTEXT OF KNOWLEDGE ON THE ALTERNATIVE ENERGY SOURCES IN PHYSICS EDUCATION IN HIGHER EDUCATIONAL INSTITUTIONS

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## ПЕДАГОГИЧЕСКИЕ ИССЛЕДОВАНИЯ И ИХ СТАТИСТИЧЕСКИЙ АНАЛИЗ В ФОРМИРОВАНИИ КОНТЕКСТА ЗНАНИЙ ПО АЛЬТЕРНАТИВНЫМ ЭНЕРГЕТИЧЕСКИМ ИСТОЧНИКАМ В ФИЗИЧЕСКОМ ОБРАЗОВАНИИ В ВЫСШИХ УЧЕБНЫХ ЗАВЕДЕНИЯХ

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**ANNOTATION**

This article describes pedagogical experiments undertaken on the possibility of developing the lectures and practical lessons of fundamental and practical knowledge on alternative energy sources in physics education in higher educational institutions. The article also outlines the results and analysis of pedagogical experimental research on the development of scientific-creative and self-study activities on the basis of fundamental and practical knowledge in the context of alternative energy sources of students.

**Keywords**: helio-technology, alternative energy sources, experimental-test, circle classes, self-study, academic activity, designing abilities, creative thinking, knowledge, skills and qualifications, modern knowledge, lesson effectiveness, creativity.

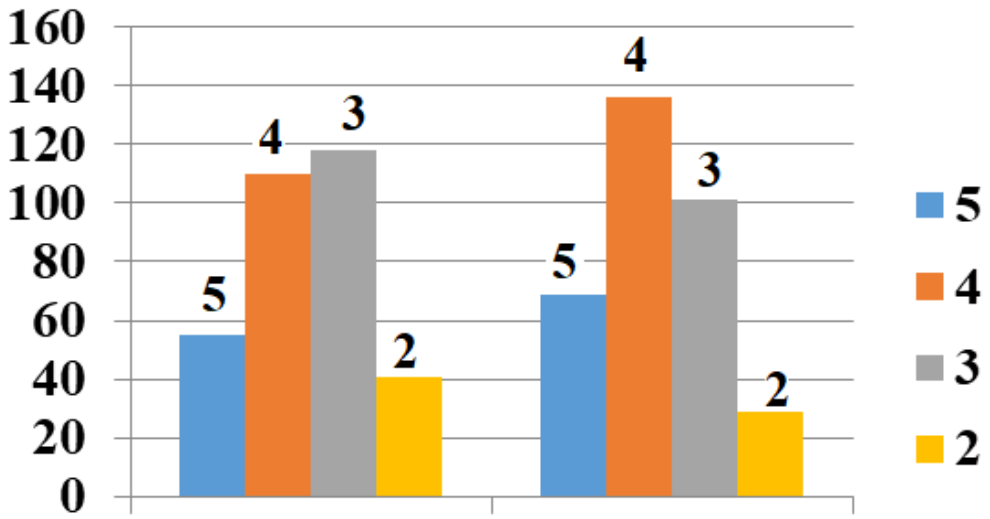
At present, the energy system requires the use of environmentally pure energy (such as solar, wind, river, sea and ocean water, atom). In order to solve these problems, it is necessary relevant develop of the culture of rational use of energy, especially in young people. For this reason, it is important to provide information on the energy shortage and prevention issues in the process of the continuing education system for natural sciences [1]. There are a number of inventions in the area of alternative energy sources, based on the results of research, new variants of a number of devices have been created, enough experience has been accumulated in the national economy, but there are tasks that should be solved in the use of the above research data in the educational system in our Republic [2]. In this regard, this article presents pedagogical experiments on statistical and practical knowledge of alternative energy sources in the teaching of physics in higher educational institutions and their statistical analysis. The pedagogical researches in the system of higher education were mainly conducted at Termez State University and Termez branch of Tashkent State Agrarian University. The researches were conducted in teaching selective subjects on the specialty 5140200 – “Semiconductors and dielectrical physics”, and the specialty of "Heliotechnology and non-traditional energy sources" at Termez State University (academic years 2010-2018). Moreover, there was carried out researches in teaching the subject "Physics and agrometeorology" at Tashkent State Agrarian University (academic year 2017-2018). In addition, pedagogical experiments were also conducted in the science circle Creative Physicist" (academic years 2010 - 2018), organized at the Department of Physics at Termez State University. Interactive methods of teaching, multimedia educational resources and demonstration models were used effectively during the research. At the beginning of the experiment, experimental testing groups were selected. In the course of teaching selective subject named Heliotechnology and non-traditional energy sources, firstly the standard curriculum, working curriculum, calendar thematic themes were developed according to the hours allocated for the course. The teaching-methodological complex, description of lab works, technological maps of the topic, equations, tests, presentations, and handouts on this subject have been developed. A total of 74 hours, including 18 hours of lectures, 12 hours of semianr, 10 hours of experimentation and 34 hours of self-study, were provided for the course of "Heliotechnology and non-traditional energy sources". On the basis of experimental-testing the number of students in some groups have deffered, with the same control and test scrutiny as initial and the level of their knowledge at the end of the study. Their level of knowledge was analyzed using $\chi^2$ statistical criteria. The system of assessment in higher educational institutions is 100 points, which we use in the following four categories: "5" (86-100 points), "4" (71-85), "3" (55-70) and "2" (less than 55 points). Calculations

$$T = \frac{1}{n_1 n_2}\left\{\frac{(n_1 O_{21} - n_2 O_{11})^2}{O_{11} + O_{21}} + \frac{(n_1 O_{22} - n_2 O_{12})^2}{O_{12} + O_{22}} + \frac{(n_1 O_{23} - n_2 O_{13})^2}{O_{13} + O_{23}} + \frac{n_1 O_{24} - n_2 O_{14}}{O_{24} + O_{14}}\right\} \quad (1)$$

according to the formula, the results of the examination of students' knowledge of the experimental testing groups selected at the beginning of the academic year 2012-2018 were as follows:

$$T = \frac{1}{57 \cdot 55}\left\{\frac{(57 \cdot 12 - 55 \cdot 9)^2}{9+12} + \frac{(57 \cdot 22 - 55 \cdot 9)^2}{9+22} + \frac{(57 \cdot 17 - 55 \cdot 14)^2}{14+17} + \frac{(57 \cdot 6 - 55 \cdot 9)^2}{9+6}\right\} = \quad (2)$$
$$= \frac{1}{3135}\left\{\frac{(684-495)^2}{21} + \frac{(1254-990)^2}{40} + \frac{(969-770)^2}{31} + \frac{(342-495)^2}{15}\right\} = 2{,}0$$

Based on the above-mentioned statistical analysis, zero hypothesis can be accepted as the result of the calculation is T = 2,0 < $T_{kp}$ = 7,81. It can be seen that the knowledge in the test experiments performed before the experimental test groups is almost identical. This is also confirmed by the diagram below.




*Picture 1. Diagram of pre-experimental testing results for the academic years of 2012-2018.*

The diagram shows that in the academic years of 2012-2018 the research was tested on the basis of the same control questions from experimental groups. After the survey, questions and tests for control were re-constructed, and their knowledge was tested on that basis. These results can be seen on the basis of calculations for the academic year of 2012-2013:

$$T = \frac{1}{57 \cdot 55}\left\{\frac{(57 \cdot 18 - 55 \cdot 10)^2}{10+18} + \frac{(57 \cdot 25 - 55 \cdot 14)^2}{14+25} + \frac{(57 \cdot 12 - 55 \cdot 23)^2}{23+12} + \frac{(57 \cdot 3 - 55 \cdot 8)^2}{8+3}\right\} = \quad (3)$$
$$= \frac{1}{3135}\left\{\frac{(1026-550)^2}{28} + \frac{(1425-770)^2}{39} + \frac{(684-1265)^2}{35} + \frac{(171-440)^2}{11}\right\} = 11{,}3$$

These calculations were done in the same way for all academic years of 2012-2018. The results obtained at the beginning of the experiment for the pedagogical experiment are illustrated in Table 1 and Picture 1 in the diagram, and the results obtained at the end of the research are described in Table 2 and Picture 2.

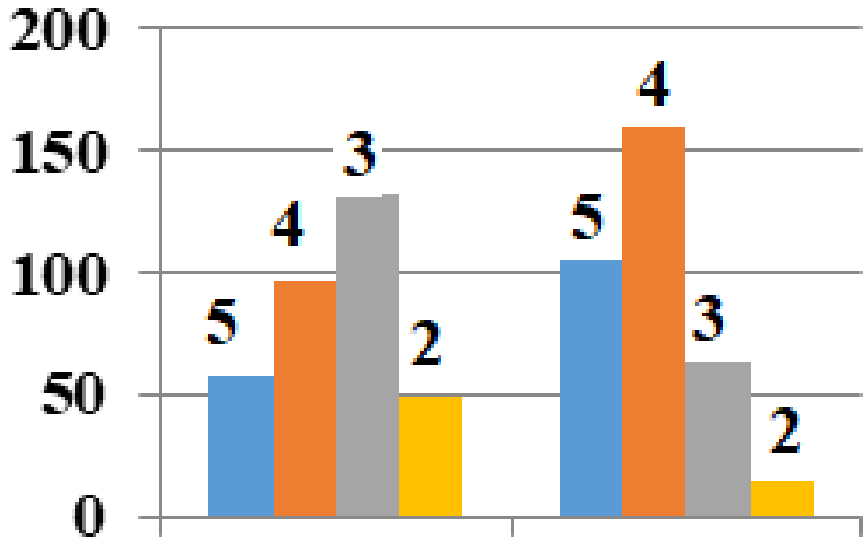
Table 1.

**Indicators of pre-experimental students' knowledge of the research**

| Academic year | Number of students | Experiment group | | | | Number of students | Control group | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Types of assessment | | | | | Types of assessment | | | |
| 2012-2013 | 57 | 12 | 22 | 14 | 6 | 55 | 9 | 10 | 17 | 8 |
| | % | 21 | 38,5 | 24,5 | 10,5 | % | 16,3 | 18,1 | 30,9 | 14,5 |
| 2013-2014 | 60 | 13 | 24 | 18 | 5 | 59 | 10 | 19 | 24 | 6 |
| | % | 21,6 | 40 | 30 | 8,4 | % | 16,9 | 32,2 | 40,6 | 10,1 |
| 2014-2015 | 60 | 11 | 27 | 16 | 6 | 60 | 12 | 18 | 22 | 8 |
| | % | 18,3 | 45 | 26,6 | 10 | % | 20 | 30 | 36,7 | 13,3 |
| 2015-2016 | 58 | 13 | 25 | 15 | 5 | 56 | 8 | 24 | 17 | 7 |
| | % | 22,4 | 43,1 | 25,8 | 8,6 | % | 14,2 | 42,8 | 30,3 | 12,5 |
| 2016-2017 | 53 | 10 | 21 | 18 | 4 | 53 | 9 | 21 | 18 | 5 |
| | % | 18,8 | 39,6 | 33,9 | 7,5 | % | 16,9 | 39,6 | 33,9 | 9,4 |
| 2017-2018 | 50 | 10 | 17 | 20 | 3 | 52 | 7 | 18 | 20 | 7 |
| | % | 20 | 34 | 40 | 6 | % | 13,4 | 34,6 | 38,4 | 13,4 |
| **Total** | **338** | **69** | **136** | **101** | **29** | **335** | **55** | **110** | **118** | **41** |
| | **%** | **20,4** | **40,2** | **29,8** | **8,5** | **%** | **16,4** | **32,8** | **35,2** | **12,2** |

We know that the knowledge and control results of physics education carried out on the basis of our recommendation in the zero hypothesis do not have any effect. Therefore, the difference in results was not statistically significant, that is, randomly assumed. However, the results of experiments are confirmed by the zero hypothesis. Consequently, our recommendations have led to statistically significant results.

The experimental results of the research have shown that students' knowledge, skills and abilities in the context of alternative energy sources can further improve the physics education process. This, in turn, demonstrates the effectiveness of our pedagogical research and the reliability of our methodological recommendations in pedagogical terms (Table 1). We have summarized the findings of the results of the experimental results, and tried to describe the results of the survey in one diagram (Picture 2). This diagram illustrates the results and evidence of the advantages of methodical and didactic learning in experimental groups.




*Testing group Experiment group*

*Picture 2. The experimental-test results diagram for the academic years of 2012-2018.*

Table 2.

**Results of experiment and control group assessment**

| Academic year | Number of pupils | Experiment group | | | | Number of students | Control group | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Types of assessment | | | | | Types of assessment | | | |
| 2012-2013 | 57 | 18 | 25 | 12 | 3 | 55 | 10 | 14 | 23 | 8 |
| | % | 31,5 | 43,8 | 21 | 5,2 | % | 18,1 | 25,4 | 41,8 | 14,5 |
| 2013-2014 | 60 | 21 | 27 | 10 | 2 | 59 | 12 | 18 | 20 | 9 |
| | % | 35 | 45 | 16,6 | 3,3 | % | 20,3 | 30,5 | 33,8 | 15,2 |
| 2014-2015 | 60 | 20 | 26 | 11 | 3 | 60 | 11 | 17 | 22 | 10 |
| | % | 33,3 | 43,3 | 18,3 | 5 | % | 18,3 | 28,3 | 36,6 | 16,6 |
| 2015-2016 | 58 | 18 | 29 | 12 | 1 | 56 | 9 | 18 | 20 | 9 |
| | % | 31 | 50 | 20,6 | 1,7 | % | 16 | 32,1 | 35,7 | 16 |
| 2016-2017 | 53 | 15 | 27 | 8 | 3 | 53 | 8 | 16 | 22 | 7 |
| | % | 28,3 | 50,9 | 15 | 5,6 | % | 15 | 30,1 | 41,5 | 13,2 |
| 2017-2018 | 50 | 13 | 25 | 10 | 2 | 52 | 7 | 14 | 25 | 6 |
| | % | 26 | 50 | 20 | 4 | % | 13,4 | 26,9 | 48 | 11,5 |
| **Total** | **338** | **105** | **159** | **63** | **14** | **335** | **57** | **97** | **132** | **49** |
| | **%** | **31** | **47** | **18,6** | **4,1** | **%** | **17** | **28,9** | **39,4** | **14,6** |

Based on the results of the research, the following results were obtained for T-statistical observation:

$T_{obs} = 11,3$; $T_{obs} > T_{krit} = 7,81$(2012/2013);
$T_{obs} = 12,0$; $T_{obs} > T_{krit} = 7,81$(2013/2014)
$T_{obs} = 11,9$; $T_{obs} > T_{krit} = 7,81$(2014/2015);
$T_{obs} = 14,1$; $T_{obs} > T_{krit} = 7,81$(2015/2016)
$T_{obs} = 11,4$; $T_{obs} > T_{krit} = 7,81$(2016/2017);
$T_{obs} = 13,2$; $T_{obs} > T_{krit} = 7,81$(2017/2018)

The experiment-testing results and their analysis in teaching the subjects the specialty 5140200 – "Heliotechnology and non-traditional energy sources" “Semiconductors and dielectrical physics”, at Termez State University and teaching “Physics” science at the Termez branch of ToshSAUwere given the following infromantion:

- During the course that undertaken the research, the students will be able to explore alternative types of renewable energy sources (such as solar photovoltaics, wind power, geothermal energy, bioenergetics, mini and micro hydropower, saline energy, ocean and sea wave energy), modern structures, methods of production, the economic efficiency and benefits of using these types of energy, and modern knowledge of future prospects, creative, non-standard thinking, independent creative work, creativity and design skills and abilities have been shaped and developed.

- During the research conducted in the course of the theoretical and practical classes, the formation of students' scientific world outlook, interest, diligence, independence, intensity, enthusiasm, creativity, constructive qualities have been shaped, and their activity in the deeper study of energy types has grown, assessment, and thereby generating sufficient knowledge, skills and qualifications on the basis of alternative energy sources.

**References:**

1. Muminov R.A., Abdiev U.B. Non-traditional energy sources in the continuous physics education. Special issue of the journal Education technology, pp. 24-26, 2012.

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